MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2022/2023 (TERM ID 2210)

ERT3046 / FERT3046 – MACHINE VISION

(RE, A.I., Security Tech.)

13 FEBRUARY 2023
2.30 p.m. - 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 4 pages excluding the cover page with 4 Questions only.

2. Attempt **ALL** questions . All questions carry equal marks and the distribution of the marks for each question is given .

3. Please write all your answers in the Answer Booklet provided .

QUESTION 1

(a) (i) Machine vision levels of operation can be classified into point level, local level; global level, and object level. Describe object level. [3 marks]

(ii) A company WXY recruits an Engineer to design an approach to detect when bottles are not full. The bottles are moved along conveyor line with automatic filling and capping stations. A bottle is considered imperfectly filed when the level of liquid is below the midway point between the bottom of the neck and the shoulder of the bottle as shown in Figure Q1a. The company has an imaging system that equipped with an illumination flash front end that can effectively stop motion so that the Engineer will be given sample image. Based on the task, design solution to detect bottles that are not filled properly for individual bottle. [12 marks]

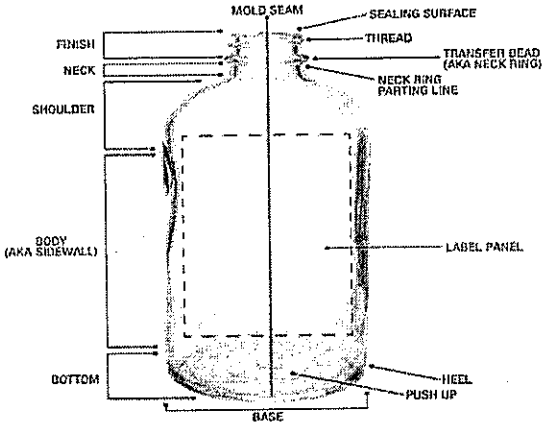


Figure Q1a

(b) From the given *Quadtree* representation shown in **Figure Q1b**, reconstruct the original image, clearly marking the object of interest. [10 marks]

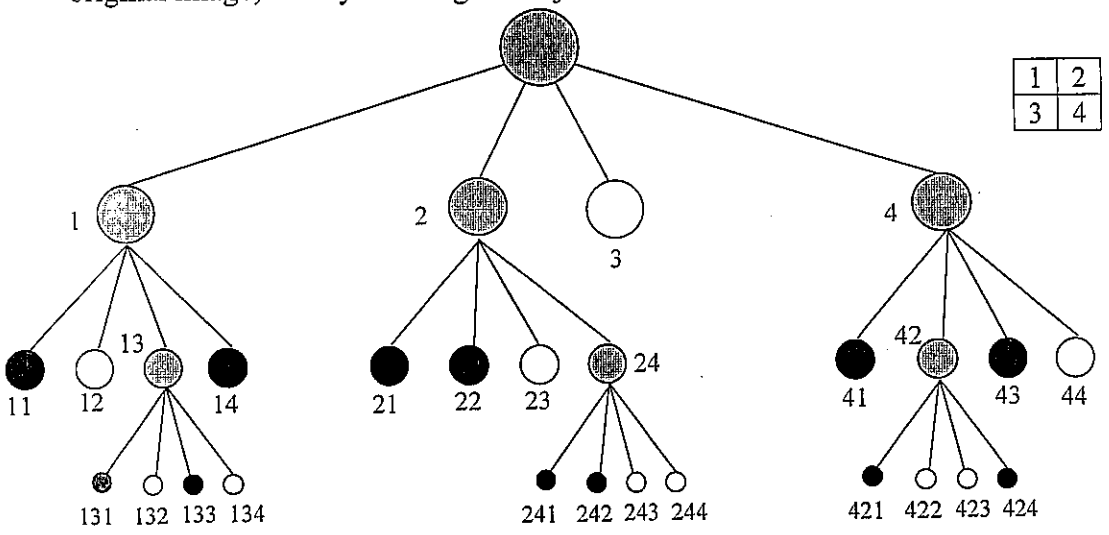


Figure Q1b

Continued...

QUESTION 2

(a) Perform the output pixel values (on the inner 4 × 4 part) on the segment 8-bits digital image shown in **Figure Q2a** after it is filtered by a 3 × 3 median mask. [9 marks]

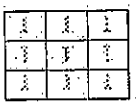
0	0	0	0	0	0
0	9	10	9	2	0
0	10	11	10	3	0
0	1	5	1	5	0
0	5	1	5	1	0
0	0	0	0	0	0

Figure Q2a

(b) A binary image A and a structure element SE are shown in **Figure Q2b.**

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	1	1	1	1	0
0	1	1	1	1	1	0
0	1	1	1	1	0	0
0	0	1	1	0	0	0
0	0	0	0	0	0	0

Binary Image A



Structure Element SE

Figure Q2b

(i) Perform the morphological *dilation* of binary image A of **Figure Q2b with** structure element SE. [4 marks]

(ii) Perform the morphological *erosion* of binary image A of **Figure Q2b with** structure element SE. [4 marks]

(iii) Apply the morphological *closing* using structure element SE. [4 marks]

(iv) Apply the morphological *opening* using structure element SE. [4 marks]

Continued...

QUESTION 3

(a) There are two basic reasons for characterization or storing of shapes namely recognition and data compression. Discuss the case of data compression. [6 marks]

(b) **Figure Q3b** shows the contour of an object indicated by the dark pixels. Perform the 8-direction Chain Code of the contour starting from **pixel A** in clockwise direction (Pixel A is the starting point).

(i) Construct the chain code for **Figure Q3b** after rotated 90^0 clockwise direction. [7 marks]

(ii) Construct the chain code for **Figure Q3b** after rotated 270^0 in clockwise direction. [7 marks]

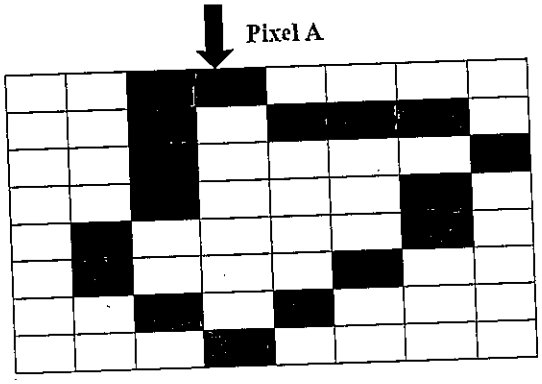


Figure Q3b

(iii) Difference code of the contour if we assume circular sequence. [5 marks]

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QUESTION 4

(a) What are the **two (2)** main approaches to define texture? Briefly explain these approaches. [4 marks]

(b) The gray level co-occurrence matrix P[i,j] is defined by first specifying a displacement vector d=[dx,dy] and counting all pairs of pixels separated by d having gray levels i and j based on the image shown in **Figure Q4b**, find the gray level co-occurrence matrix for the displacement matrices, $d = (0, 2)$. [9 marks]

2	1	2	0	1
0	2	1	1	2
0	1	2	2	0
1	2	2	0	1
2	0	1	0	1

Figure Q4b

(c) **Table Q4** shows *Confusion Matrix* which is commonly used to report results of classification experiments. Compute the following:

(i) What does row represent? [2 marks]
(ii) What does column represent? [2 marks]
(iii) Total misclassified input vectors [2 marks]
(v) Total error rate for **D** [2 marks]
(vi) Empirical error rate [2 marks]
(vii) Empirical reject rate [2 marks]

Table Q4b

	A	B	C	D	E	F	G	Reject
A	95	1	0	0	1	2	0	1
B	0	97	0	1	1	0	0	1
C	0	0	99	1	0	0	0	0
D	0	0	2	94	0	1	1	2
E	0	2	0	0	98	0	0	0
F	0	3	2	0	1	93	0	2
G	0	0	0	1	0	0	99	0

End of Paper